begins to show itself prominently early in the third year, and mechanical technology and electrotechnics are more or less taken up in the mechanical and electrical engineering courses. In the fourth year a crowd of engineering subjects is frequently introduced. An important part of the work of the fourth year is the preparation of a graduation thesis. The original intention, we find, of including such work in the time-table was undoubtedly to stimulate each student to produce, before he left the institution, a piece of original work which should be of some value in the development of science or of industry. In actual practice, however, the amount of original work produced is not very great, and it can be said fairly that only the best students do work which may be correctly dignified by the name of research. In most of the colleges post-graduate courses are organised, and in these the best work of the college is done.

But in no respect are American conditions more different from those at home than in the attitude of the employers of labour towards higher education. Just as the engineering experts on the Mosely Commission were unanimous in praising the interest shown by American manufacturers in the work of the colleges, so Dr. Walmsley testifies to the same fact. "Without exception the officials interviewed asserted that, far from having any difficulty in placing the graduates turned out year by year from the engineering courses, for the last few years the graduate class has had every one of its individual members engaged for remunerative work before the completion of the course at college." Later it is stated, "many of the large employers have made it a *sine quâ non* for entrance to any position which may lead eventually to a place on the scientific staff, that the candidate should have passed satisfactorily through the full four years' course at an approved technical institution." More than this, no premium is demanded, and living wages are given from the beginning, and these are raised as soon as the young beginner shows himself to be worth more.

Dr. Walmsley concludes his valuable paper with a summary of the respects in which this country is behind the United States so far as the education of its engineers is concerned. He enumerates the following deficiencies:—First, the comparative lack of support and encouragement of the work of the colleges by our leading manufacturers; secondly, that even were our employers ready to adopt the American plan of securing the services of students from the engineering schools, our present schools are neither equipped nor staffed to produce in sufficiently large numbers the trained men who would be wanted; and thirdly, that parents and guardians in this country have not yet been educated to understand how essential, in view of recent developments, a college training is to the success in the future of a candidate for the engineering profession.

As Mr. Buckmaster remarked during the course of the resumed discussion on Dr. Walmsley's paper, it "will be for a long time to come a sort of mine into which each of us will dig." This report together with the others to which reference has been made are more than sufficient to show educational authorities the direction in which our systems of instruction can be improved, and it is earnestly to be hoped that these and similar warnings will not have been uttered in vain. A. T. S.

ARCHÆOLOGICAL INVESTIGATIONS IN RUSSIAN TURKESTAN.

DR. D. C. GILMAN, president of the Carnegie Institution of Washington, has received a letter in which Prof. R. Pumpelly describes some interesting results of his investigations upon ancient sites, at Anau, near Aschabad, in Russian Turkestan. The following extract from this communication will be welcomed by all who are interested in prehistoric and archæological researches:—

We have explored more than 136 feet of successive culture strata, containing at least four almost uninterrupted culture stages, extending apparently for thousands of years through the Neolithic and Bronze into the beginning of the Iron stage, and we have correlated the stages of culture with important events in the physiographic history and with the introduction of irrigation.

The streams that rise in the high mountains of northern Persia emerge on to the Turkoman plains forming fans, or subaërial deltas, covering many square miles, and each making an oasis. The water is all used in irrigating these fertile spots. Beyond them is the desert. Anau, where we have excavated, is on one of these fans.

Here at Anau, about seven miles east of Aschabad, there are two great tumuli, and the ruins of a city—Anau—surrounded by moat and wall, and occupied until within the last century. The two tumuli, nearly half a mile apart, are nearly equidistant from the city at a distance of less than a mile. We have explored both of these tumuli, and I have done some work in the city.

The northern and older tumulus rises 40 feet *above the plain*; the southern and younger tumulus rises 52 feet *above the plain*. Both of these start with their lowest culture strata on slight elevations in the same original plain-surface—more than 20 feet below the present surface of the surrounding plain. That is to say, the plain has grown up more than 20 feet since the settlements began. I will show, further on, the different phases of this growth.

In the older tumulus, we find a culture occupying the lower 45 feet, and distinguished by the technique and decoration of its wholly hand-made and interesting pottery. This is succeeded in the upper 15 feet by a more advanced culture in which some remnants of bronze implements and lead beads (all wholly altered to salts of the metals) show a beginning acquaintance with bronze, while the still hand-made pottery has changed and become more developed. Throughout this tumulus we have found nothing recognisable as a weapon of offence in either stone or metal, though flint knives abound.

The southern, younger tumulus, starts with a developed wheel-made pottery, unpainted, and of a technique wholly different from that of the older tumulus—though some hand-made pottery occurs not wholly unlike some of the younger products of the older tumulus.

From its base under the plain to its summit this tumulus has 74 feet of culture strata. There are evident here at least two successive cultures. Of these, that of the lower 62 feet is wholly in the bronze stage (but with survival of flint implements), while the upper 14 feet are marked by decided changes and by the introduction of iron, of which the wholly oxidised remnants of some implements were found.

We have thus at least four distinct cultures occupying 136 feet, with a break in the column between the end of the old and the beginning of the new tumulus. We do not know how great this gap may be.

Through all the cultures except the last—that of the iron stage—there ran a remarkable and characteristic burial custom. The children—at least certain children—and seemingly only children, were buried in the houses, under the floor, on a layer of fire-hardened earth.

In addition to the work on the two tumuli, I have sunk four shafts to the culture strata (30 to 40 feet thick) of the city of Anau, to try to determine its age relative to that of the youngest culture of the tumuli, and to get facts for use in deciding as to when irrigation was introduced. The results prove that Anau was wholly in the iron stage, while its wheel-made pottery is wholly different from any in the tumuli; but, in addition to this, fine-glazed faience was found plentifully in the upper three-quarters of all three shafts. These were not found at all in the tumuli, excepting in the case of two or three isolated and very doubtful pieces.

The history of the whole series of culture strata is sharply characterised by the following four periods in the history of the plain or subaërial delta:—

(1) The north tumulus when founded stood on a hill at least 7 feet, and probably more, above the plain surface, its culture spreading down the slopes. The plain was aggrading, and continued to grow until it had buried the base of the tumulus to a depth of 2 feet. By that time, or soon after, the north tumulus was abandoned, and the south tumulus culture founded, on an elevation about 2 feet above the plain. The plain continued to grow until it had buried the base of the south tumulus to a depth of 14 feet.

(2) Then followed a change of conditions. The plain was cut down at least 19 feet.

(3) This was followed by another change which caused the refilling of the cutting to the amount of 8 feet, 7 feet of this last growth having occurred after the deposition in

its sediments of the thoroughly characteristic pottery of the youngest (the iron culture) of the south tumulus.

(4) After this, and apparently contemporaneous with the founding of Anau, irrigation began through which the plain was raised 15 feet, bringing it to its present condition, in which the north tumulus stands embedded to a depth of 27 feet, the south tumulus to the depth of 22 feet, and Anau to 15 feet.

EFFECT OF SOUND ON WATER JETS.[1]

THE structure of water jets was first investigated by M. Savart, who in 1833 published a series of beautiful papers in the *Annales de Chimie et de Physique*. Since then it has received the attention of many experimenters, notably M. Plateau and Prof. Magnus, while of later years our knowledge of the subject has been much added to by the observations and mathematical researches of Lord Rayleigh. The older experimenters had to content themselves with observing the jet through a revolving disc with radial slots, but by means of an electric spark and rapid plates we can now secure photographs of the jet at any desired instant. The eye shows us that a jet of water consists of two parts, (1) a clear column, and (2) a troubled portion. The spark reveals to us that the troubled portion, though apparently continuous, is really a succession of drops, which move too rapidly for the eye to perceive them as such while under continuous illumination.

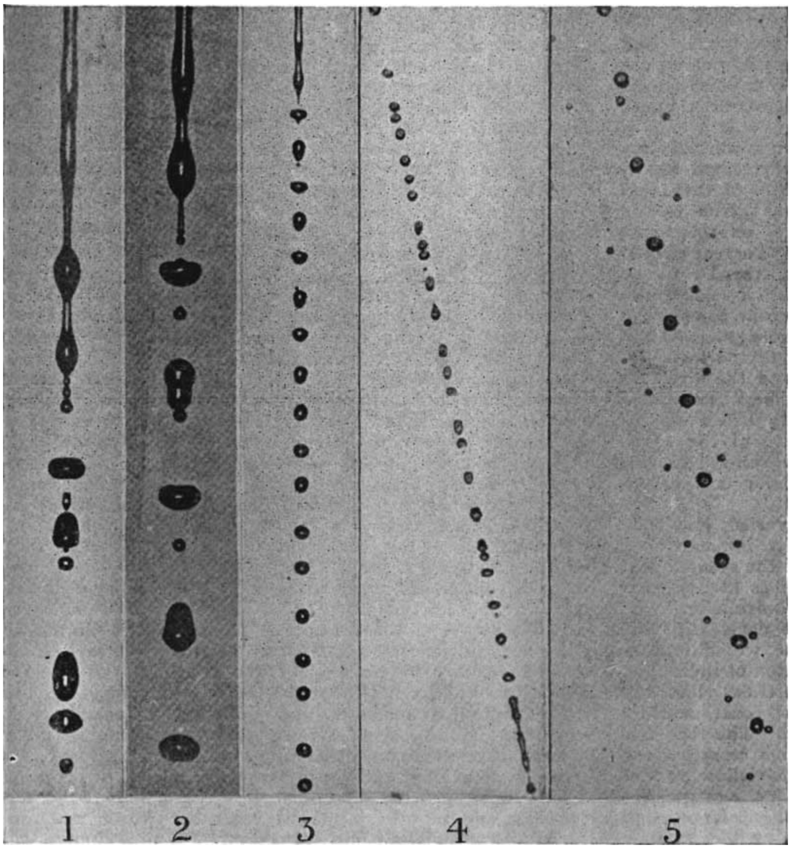

FIG. 1.—Some Instantaneous Photographs of Water Jets.

Towards the lower part of the clear column of water the jet presents alternate swellings and contractions, and at the very extremity a drop is cast off, leaving behind a connecting ligament, which separates and forms a smaller drop (Fig. 1). If the jet is falling freely, and subject only to accidental tremors and disturbances, the formation of drops is by no means regular, and the sizes and shapes of the drops vary much. If a vibrating tuning fork be held in contact with the stand, and if the pressure of water and the diameter of the orifice be suitable, the jet will appear like a vibrating string, a succession of nodes and loops being formed. The effect of the tuning fork is to render the separation of the drops regular, a drop being cast off with each vibration of the fork. If the jet be falling vertically, as the drop leaves the end of the clear column it is extended in a horizontal direction, but as it falls it oscillates about the spherical form, being alternately elongated and compressed under the action of the surface tension of the liquid (Fig. 2).

Prof. Magnus explained that the wavy appearance of the jet under the action of the tuning fork was due to all the drops which arrive at any given point of space being in the same phase; at the middle of a swelling they are most elongated horizontally, and midway between the broadest portions of two consecutive swellings they are most elongated vertically.

These remarks apply to a jet of water about 2 mm. in diameter. If the diameter of the jet be much less than 1 mm., swellings are not produced in it. The effect of a tuning fork is to render the drops practically equidistant and uniform in size (Fig. 3). If a fine jet be projected upwards (Fig. 4) it will be seen to consist of irregular drops, while the effect of a tuning fork upon it is often to cause it to break up into several distinct streams (Fig. 5).

[1] "The Structure of Water Jets, and the Effect of Sound thereon." By Philip E. Belas, Royal College of Science, Dublin. With photographs. Abstract of paper read before the Royal Dublin Society on March 15.

THE POISON OF THE BANDED KRAIT.[1]

THERE is an unbounded field in India for the study of the venoms of the many species of poisonous snakes met with in that country, and the Government of India has been well advised to devote to this subject certain of its scientific memoirs now being issued from time to time. Captain Lamb, I.M.S., the author of the one under review, has already done good work in this branch of research.

The venoms of various snakes, though all composed of the same class of chemical substances (coagulable proteids and proteoses) in varying proportion, differ markedly in their physiological actions, and it can be shown not only physiologically, but also by certain test-tube reactions, that the proteids and proteoses are different in the different venoms.

Thus the blood serum of an animal that has been injected with cobra venom causes a precipitate when mixed with an aqueous solution of cobra venom, but has no such action when mixed with a solution of the venom of the Australian tiger snake. As regards the venom of the banded krait (*Bungarus fasciatus*), with which this memoir deals, Captain Lamb's researches show that cases of poisoning may be divided into three classes:—(1) those in which after a large dose rapid death follows from the occurrence of extensive blood coagulation in the blood vessels; (2) those which are fatal after two or three days, and present acute

[1] Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India. No. 7, 1904. "Some Observations on the Poison of the Banded Krait (*Bungarus fasciatus*)." By Captain George Lamb, M.D., I.M.S. (Calcutta: Government Printing Office, 1904